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MEASURING NON MONETARY INNOVATION IN SOFTWARE: A CASE STUDY IN FLOSS FIRMS FROM ARGENTINA

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ABSTRACT

This paper presents a critical review of the design of innovation surveys that follow the Oslo Manual standards, based on a series of case studies in Free/Libre Open Source Software (FLOSS) companies. The main objective of the article is to propose criteria for measuring innovation in software that consider the specificities of the non-monetized innovation generated in the FLOSS community, helping to overcome relevant limitations of the current sectorial surveys based on the Oslo Manual. We applied a qualitative analysis based on seven case studies in FLOSS firms from Argentina, mainly through semi-structured interviews to key informants. Such analysis was aimed to elucidate the nature and particularities of the innovation processes and outcomes in the firms, the characteristics of the collaboration with the community and its role in the business model and innovation strategy of the organizations. The main results of the empirical study are: a) a criticism of the monetary conception of the predominant innovation in the manuals of the area and b) on this basis emerges a series of recommendations to improve the measurement of innovation through surveys in the software sector , such as: the consideration of publicly released products and developments and contributions to third-party products in the FLOSS community, the incorporation of performance indicators of firms not based on sales from innovation, and the consideration of innovation selection mechanisms typical of FLOSS communities not based on their market impact.

Keywords: Non Monetary Innovation, FLOSS firms, Innovation Surveys, Case study, Argentina.

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MENSURANDO A INOVAÇÃO NÃO MONETÁRIA EM SOFTWARE: UM ESTUDO DE CASO EM EMPRESAS DE CÓDIGO ABERTO (FLOSS) DA ARGENTINA

RESUMO

O artigo apresenta uma revisão crítica à concepção de pesquisas de inovação que seguem as normas do Manual de Oslo, com base em uma série de estudos de caso em empresas de software livre ou de código aberto (FLOSS). O objetivo principal do artigo é propor critérios de mensuração para inovação de software que considerem as especificidades da inovação não monetizada gerada na comunidade FLOSS, ajudando a superar as limitações relevantes dos atuais levantamentos setoriais baseados no Manual de Oslo. Aplicou-se uma análise qualitativa baseado em sete estudos de caso em empresas FLOSS da Argentina, principalmente através de entrevistas semi-estruturadas com informantes-chave. Essa análise teve como objetivo elucidar a natureza e as particularidades dos processos e resultados da inovação nas empresas, as características da colaboração com as comunidades de software libre, e seu papel no modelo de negócios e estratégia de inovação das organizações. Os principais resultados do estudo empírico são: a) uma crítica à concepção monetária da inovação predominante nos manuais da área e, com base nisso, b)uma série de recomendações para melhorar a mensuração da inovação por meio de pesquisas no setor de software que incluem, entre outros aspectos, a consideração de produtos liberados, e de desenvolvimentos e contribuições para produtos de terceiros na comunidade FLOSS, a incorporação de indicadores de desempenho de firmas não baseadas em vendas de inovação, e a consideração de mecanismos de seleção de inovações não baseadas em seus impactos no mercado.

Palavras-Chave: Inovação não monetária, Empresas de software livre, Pesquisas de Inovação, Estudo de caso, Argentina.

INTRODUCTION

It has been more than two decades since many Latin American countries began to undertake innovation surveys as an input to innovation and development policies design. More than 15 Latin American countries performed innovation surveys, some of them with several waves and some even including service sectors. That led to scholars in the field of innovation studies in the region to make a balance of the evolution of innovation surveys, their limitations and the degree of adequacy to domestic needs.

In pursuing that, despite the several limitations of current surveys, there is also a recent concern and need to consider new innovation metrics. In her Keynote Speech of the 13th Globelics International Conference in La Habana (Cuba), Monica Salazar, one of the authors of the Bogotá Manual sustained this view (Salazar, 2015). Among the concerns pointed out, there is the challenge to combine qualitative and quantitative metrics and the question of how to consider other novel types of innovation. In particular, how to include in our surveys the innovations of the public sector and the diversity of outcomes from the academic community (mostly in the Latin American context, where developmental Universities stand out), and how to consider and value social, inclusive and grassroots innovations, many of them developed by communities. In a word, how to develop new innovation metrics better suited to local needs.

The traditional firm-related innovation concepts and metrics were originally developed according to developed economies needs, and a reconsideration is needed. In this paper we try to contribute to the Latin American research agenda in this issue, in pursuit of new innovation metrics for inclusive development (Dutrénit & Sutz, 2014; Dutrénit & Zúñiga, 2013; LALICS, 2012). Our focus will be the need of a particular consideration of non-monetary innovation, as many of the outcomes from the Free/Libre Open Source (FLOSS) activity.

Many of the innovations created in the FLOSS activity are not directly monetized, which

introduces a particular difficulty to traditional measuring methods. The FLOSS activity involves an interaction with the community where several transactions are non-monetary, which arises the problem to measure and to quantify their economic relevance (Ghosh, 2003). Even more, one of the major issues that economics has failed to understand is how firms operate when their developments and innovations are open access, and often free-of-charge. Moreover, how a firm, like FLOSS firms, can be motivated to collaborate in community projects despite its innovations can be used by potential competitors.

The nature of the production and innovation in FLOSS activity leads many innovation surveys on the software sector to fail to take into account its relevance in the statistics. An additional complexity is that FLOSS can be produced both by individuals collaborating in the community and by public agencies and Universities, as by firms. However, as national and sectoral statistics usually come from surveys designed at the firm level, many FLOSS innovations are invisible in the statistics due to the lack of a firm-level innovation survey design that considers FLOSS.

FLOSS is crucial for developing economies with an emergent software sector, as Argentina or Brazil, for several reasons. Its presence mitigates the entry barriers to the activity, as well as solving many of the intellectual property problems regarding 'piracy'. Moreover, FLOSS allows alleviating balance of payment problems through saves in foreign licenses purchases and through substitution of imports (Moncaut & Robert, 2016).

The main objective of the article is to propose criteria for measuring innovation in software that consider the specificities of the non-monetized innovation generated in the FLOSS community, helping to overcome relevant limitations of the current sectorial surveys based on the Oslo Manual. We applied a qualitative analysis, through 7 FLOSS case studies of firms from Argentina, aimed to elucidate the nature and particularities of their innovation processes and outcomes, and the characteristics and role of the collaboration with the community in the business model and innovation strategy of the firm. Afterwards, we apply these insights to critically evaluate the traditional standards that guide the measuring of innovation in the software activity, particularly from the Oslo Manual.

THEORETICAL AND EMPIRICAL ANTECEDENTS. FLOSS AND INNOVATION AS A MONETARY CONCEPT

Traditional views in the innovation literature

Technical change and innovation are at the center of economic change and growth in capitalist economies. It is a fact widely accepted in economic theory, both from orthodox (Solow, 1956, 1957) and heterodox views (Dosi, Freeman, Nelson, Silverberg, & Soete, 1988; Freeman & Soete, 1997; Lundvall, 1992; Nelson & Winter, 1982). However, traditional economics has failed to conceptualize the innovation phenomenon properly, fundamentally by their strict adherence to certain assumptions –as optimization behaviour at a micro level the notion of equilibrium, the neglect of real uncertainty, among others. That is the reason why heterodox views from schumpeterian, institutionalism and learning theories have become dominant in the innovation literature.

In general terms, Schumpeter (1911), distinguished five types of innovations: i) introduction of new products, ii) introduction of new methods of production, iii) opening of new markets, iv) development of new sources of supply for raw materials or other inputs, v) the creation of new market structures in an industry. Innovations are subject to a social selection process, non *ex ante* optimal (Schumpeter, 1942).

Implicitly, the main selection mechanism in capitalist economies is the market, and innovation has a monetary visible face appropriable by firms. This view is adopted by the Oslo Manual: *'A Schumpeterian perspective tends to emphasise innovation as market experiments and to look for large, sweeping changes that fundamentally restructure industries and markets'* (OCDE, 2005). Innovation manuals (Jaramillo, Lugones, & Salazar, 2001; OCDE, 2005) are also influenced by approaches as evolutionary innovation theories (Nelson & Winter, 1982), theories of innovation systems (Lundvall, 1992; Nelson & Winter, 1982) and some organizational innovation literature (Lam,

2005) ; but the schumpeterian conceptions are their main theoretical basis.

From the Oslo Manual perspective, the sourcing of innovations in firms are two: i) to adopt innovations from other actors (firms or institutions) as part of a diffusion process; ii) to invest in creative activities to innovate, namely in innovative activities (e.g.: R&D expenditures). In this line, innovation refers to new products, new production processes and new organizational set-ups introduced in the market, while innovative activities concern the search for experimentation, development, imitation and adoption of this kind of novelties. That is the core of the Oslo Manual that guides innovation measurement in many sectors.

Claims from Latin-American scholars in the late nineties in the Bogota Manual about the lack of consideration of their innovation specificities, led to include new commercial and marketing channels as another innovation type. The 3rd edition of the Oslo Manual included these types of innovations, and incorporated a degree of novelty consideration (new to the firm, new to the domestic market, new to the international market). These conceptions came from Schumpeterian economics, and are the basis that guide the current design of innovation surveys that follow the Oslo Manual or the Bogota Manual (Jaramillo et al., 2001; OCDE, 2005). Implicitly, innovation refers to an idea introduced to market-selection processes that, one way or another, is monetized and (at least partially) appropriated by the firm, reinforcing their economic position.

Many innovation surveys in the software sector that adopt an assimilation-to-manufactures approach (F. Gallouj & Savona, 2009; Faïz Gallouj & Weinstein, 1997) follow the main standards of the Oslo Manual, with some minor adaptations to the sector. Moreover, it implicitly considers a monetary conception of innovation. However, the innovation literature has pointed out other kinds of innovations, as the innovations of the public sector and outcomes from the academic community, social innovations, inclusive innovations and grassroots innovations, which are not implemented by the Oslo Manual to be measured at the firm level.

Nevertheless, many of these kinds of non-monetary innovations are undertaken in the FLOSS universe, even by firms. The FLOSS activity involves an interaction with the community where several transactions and innovations are non-monetary (Ghosh, 2003). It opens a research path to discuss the traditional conceptions of innovations, and mainly the ways to measure it in the innovation surveys.

Free/Libre Open Source Software firms and Innovation

The origins of the production of software are related to the efforts made by engineers and scientists of academic, government or corporate labs; embedded in sharing practices, in the free exchange of software, and in the writing of software upon previous code and programs available for free, as well as in their research and development culture. In that sense, software production is an activity that was privatized by mid-1970s with its separation from hardware, thus making software a separate marketable product.

The Free Software movement arose in the academic sphere (mainly, in the MIT and Harvard) as a reaction against the proprietary software production. Richard Stallman led this reaction in the early eighties. From its birth, the Free Software movement has transformed the software industry. By the end of the 1990s, Eric Raymond established the technological and economical virtues of the open source development model, but still allowing a business model based on proprietary software (Raymond, 1999). Since its beginnings, FLOSS has challenged the traditional business models and strategies both of SMEs and Large Multinational Corporations (Dahlander & Magnusson, 2005).

Briefly, a software is FLOSS if the users have the freedom to run, copy, distribute, study, modify and improve it. Free software does not refer to free-of-charge, but in the sense of freedom (which leads to the use of the term '*Libre*', to avoid the English language confusion with the term 'Free'). Software is Open Source, when its source code is available with the executable versions. The open source licenses (e.g.: GPL) guarantee that the source code

remains in the public sphere, protecting it from private appropriation. To be considered also as Free Software, it must: i) be available in the public sphere; ii) respect the four basic freedoms of Free Software: the freedoms to use (freedom 0) , study (freedom 1), distribute (freedom 2), modify and improve it (freedom 3) (Stallman, 1983). An open-source software can also be Free Software if it complies with the four freedoms. In operative terms, from a production and economic perspective, Free/Libre Software and Open Source Software can be used indistinctly, or jointly, as FLOSS.

Several recent studies have considered FLOSS from an economic point of view, both globally (Crowston et al., 2016) and regarding Argentina (Robert, 2013; Zanotti, 2015), making relevant contributions on the dynamics and effects of its diffusion, the relevance of connectivity in production or the dynamics of productivity in this productive segment.

However, the fact that from an economic point of view the FLOSS activity in the related communities raises the problem of the lack of measurable and quantifiable monetary transactions (Ghosh, 2003), has not been addressed as such. This problem leads to the scarcity of empirical data in a big scale to take into account the FLOSS relevance in the software industry statistics and, naturally, its contribution to innovation.

The innovation literature on FLOSS often focuses on the project or on the community level of analysis (Kogut & Metiu, 2001; Lee & Cole, 2003; Mani & Mukherjee, 2017; O'Mahony, 2003; Von Grogh, 2003; E. von Hippel & von Krogh, 2009; E. A. Von Hippel, 2005). A first stylization of the development and innovation process can be done following these antecedents, usually as a result of case studies (Kogut and Metieu (2001) study the Linux and Apache cases. Von Hippel and von Krogh (2009) and von Hippel (2005) present the cases of Fechmail and Apache. Lee and Cole (2003) study the case of Linux in general. O'Mahoney (2003) study the appropiability conditions in 6 community projects: GNU, Linux kernel, Apache, Debian, Gnome and Linux standard base).

At this analysis level, a FLOSS project is a community web-based development software project. This community is characterized by a production model where the programming work is distributed and dispersed, even globally. Its members share norms and a culture, which together with the license standards, guarantees the freedom of the shared knowledge and prevents privatization practices. A FLOSS project is typically initiated by an individual or a small group seeking for a solution to a personal, organizational or social need. It is usually organized in two types of groups: a core and a periphery.

The core group includes the authorities of the project, its leaders (where the initiators of the project and the idea usually are) and a series of maintainers that evaluate the contributions received from the periphery to the source code, and eventually accept or reject it, to sustain the desired quality of the software. Moreover, they establish some of the norms of the community, and the selection mechanisms of the improvements.

The periphery is composed by a large (in the most successful projects) number of developers that test the software, report bugs and failures, and propose patches or improvements to the source code. This kind of organization is non-structured, but founded on meritocratic societies.

There is not a formal mechanism for recruiting contributors for projects and, in that sense, there aren't formal contracts between the developers and the project, and the relation is, to a large degree, volunteer (For a study of individual motivations to collaborate see O'Mahony, 2003). The development process is grounded on free-development tools, a shared infrastructure that allows the hosting of the project (e.g. GitHub) and the monitoring and testing of changes. This includes mailing lists to particular aims, as bug reporting, the debate of ideas and the availability of essential development tools. This organization of the development process allows the introduction of several high quality innovations (successive improvements to the code) and a wide collective learning process. Several members of the community carry out a critical evaluation process upon which the aforementioned innovations and learnings are based (Lee and Cole, 2003).

This kind of innovation process makes the measurability of innovation specially difficult,

since it occurs in a disperse (even globally) way and distributed in a community. As a result, the most salient surveys on FLOSS production take as observational units the software workers and developers collaborating in community projects: the WIDI 2001 survey (Robles, Scheider, Tretkowski, & Weber, 2001), the BCG Hacker Survey 2002 (Lakhani, Wolf, Bates, & DiBona, 2002), the FLOSS 2002 survey from UNU MERIT (UNU MERIT & Berlecon Research, 2002), the UNGS-SADIO 2004 survey (Borello, Erbes, Robert, Roitter, & Yoguel, 2005; Borello, Robert, & Yoguel, 2006; Robert, 2006), and the survey from the FLOSS WORLD 2007 project (MERIT, 2007).

Even more, some authors propose a smaller observational unit to quantify non-monetary transactions, through the authorial decomposition of the source code from open source projects (Conklin, 2007; Ghosh, 2003). However, it is a problematic proposal, because a survey designed at that observational level does not allow to clearly input the innovation activity at organizations and firms.

At the same time, sectoral and national statistics come from surveys that measure the economic and innovation activity at firm level. As a result, FLOSS innovation and its economic impact –in terms of employment, direct or indirect sales and exports, diffusion of product, processes or organizational innovations, etc. – are invisible in technological and innovation statistics.

There is a lack of innovation surveys oriented to FLOSS firms. Innovation literature identifies a series of aspects that motivate firms to participate in FLOSS communities with impact in their innovation activities (Colombo, Piva, & Rossi-Lamastra, 2013, 2014).

There are many ways in which firms can in-source knowledge from FLOSS communities. Some FLOSS firms can download OS code and adapt it to the need of their customers to develop specific solutions, as a way to source their innovation and production processes. Furthermore, they can contribute to FLOSS projects by paying their workers to devote working time to participate in mailing lists and to write documentation, code for the projects, debug code, or answer technical questions and solve problems.

In leading FLOSS projects in the community and/or releasing publicly in-house developed software, firms can freely receive suggestions from individual volunteers and others firms, code debugging, complementary modules for their software, or user assistance and support. The communities offer access to abundant free-off-charge external resources, as free tools or infrastructure, and commercial resources such as reputation in high-quality software production capacities, contacts with possible customers, and alternative marketing and distribution channels (Colombo et al., 2014; West & O'Mahony, 2008).

Any kind of software can be successfully advertised through the community, and its acceptance is usually viewed as a 'quality certification', at least a 'quality capacity proof', which could reinforce the reputation and position of the firm in the market.

All these knowledge sources can input the innovation processes of the firm, and are fungible to the development of any software product and to provide diverse services. In order to put the aforementioned sources in value and to benefit from these resources, the participation in FLOSS communities is essential. The firm can even act as an 'insider', if it achieves a proper status in the community that allows it to affect the directions of FLOSS projects in their own interests (Capra, Francalanci, Merlo, & Rossi-Lamastra, 2011).

These aspects are the first insights from the literature regarding the ways in which FLOSS community can source knowledge for innovation in the firms, which should be verified and considered in the ways we conceptualize and measure innovation in the software sector when we are seeking to treat firms as observational units.

METHOD AND DATA SOURCES

To identify some specificities of innovation in FLOSS firms, we applied a qualitative methodology based on case studies through a series of interviews (Denzin & Lincoln, 2005; Eisenhardt, 1989; Yin, 2009). During 2012-2017 we performed 7 in-depth case studies in FLOSS firms from Argentina, which are diverse

regarding structural characteristics as size, location and production specialization.

Three cases are SME software firms from Córdoba city: Kunan employs 14 workers and is specialized in CRM solutions based on SuiteCRM (installation, customization, development of customized complementary software modules, training, migration and integration services), remote database services and mobile solutions; Machinalis employs 35 workers and is specialized in solutions and customized development of software in the fields of artificial intelligence, natural language processing, data mining, machine learning, data science and complex web development; ECIC Systems employs 7 workers and offers server administration services through a platform developed internally upon FLOSS. Two cases are free software work cooperative firms. Tecso is a cooperative located in Rosario – Santa Fe province– which employs 132 associate workers and develops customizable software (specially for the public sector, entirely FLOSS), software factory (development of parts or modules for other firms), and services as consultancy and support. The other cooperative, Gcoop, employs 18 associate workers, is located in the city of Buenos Aires, and is specialized in ERP implementations, the development of customized software, web development services, and diverse training services. The two remaining cases are software firms from Buenos Aires: Entornos Educativos, which employs 14 workers and is specialized in educational and training platforms implementations; and XTech, which employs 23 workers and offers problem-solving services for IT infrastructures.

The interviews were carried out through semi-structured questionnaires, designed with open questions around two topics: a) the nature and particularities of innovation processes and specific outcomes of the FLOSS activity; b) the characteristics and role of the collaboration with the community in the business model and innovation strategy of the firms.

Table 1. Firm data sources.

Firm	Number of interviews	Period of interviews	Informants	Total Hours of Interviews	Secondary Data
KUNAN	2	Oct 2016 – Mar 2017		3:30	II Software Innovation Survey – 2016
			Technology Manager / Owner		Papers from KUNAN workers
			Manager OS Department		CRM Suite and Sugar's community web information
					KUNAN web page
					CADESOL web
MACHINALIS	8	Oct 2013 – Aug 2014	CEO	8:40	II Software Innovation Survey – 2016
			COO		Internal Recruiting Document
			CFI / Human Resourser Manager		Python community web information
			2 Project Managers		Papers's abstracts presented on global and national conferences (PyData , PyConAr, etc..)
			1 Technical Leader		Quepy (internal project of the firm) documentation
			1 Developer		Machinalis web page
ECIC	4	Jun–Nov 2016 / Apr 2011		3:20	II Software Innovation Survey – 2016
			2 Managers / Owners		Slides presented in regional conferences from Fedora (FudCon)
					PITS (product of the fims) web information
					ECIC Systems web page

GCOOP	2	Apr 2017 / Mar 2012	1 Associate Owner / Comercial Manager	2:15	Annual memories of the Cooperative
					Drupal Assosiation web information
			1 Associate Owner / Developer & GNU Linux Administrator		Gcoop blog and web information
					Tryton-ar Github
					FACTTIC web
					CRM Suite and Sugar's community web information
TECSO	2	Apr 2017 / Jun 2016	1 Associate	2:00	Tecso web page
			Owner /		Online news
			Manager		
ENTORNOS EDUCATIVOS	1	May 2017	1 Associate	0:50	Entornos Educativos web page
			Owner		Moodle web information
X TECH	1	May 2017	1 Executive	0:50	Entornos Educativos web page
			Director		
			(CEO)		

Source: Own elaboration.

Moreover, we combined diverse data sources: web information about communities (Python, Tryton, CRM Suite and CRM Sugar, Drupal), community conferences where the firms participated (PyCon, PyAr, FudCon, etc.), and the web page information of the firms. For some cases, we have data from an innovation survey done in the software sector from Argentina during 2016. This survey provides information about production specialization, demand and market orientation, economic and innovation performance, innovative activities, quality standards certification, and use and production of FLOSS.

INNOVATION IN FLOSS FIRMS FROM ARGENTINA

In this section we present the main characterization of the cases considered regarding the particularities that the FLOSS production activities introduced. Table 2 below summarizes, in a comparative way, the most salient characteristics of the cases. Afterwards, a more detailed case to case presentation is done.

Table 2. FLOSS firms characteristics summary.

Firm	Production Technologies Used	Size (2015)		Percentage of sales from FLOSS products or services	Communities where members of the firm participate	Percentage of FLOSS released publicly
		Workers	Anual Sales(USD)			
KUNAN	HTML/CSS/JavaScript, PHP, Java, Android, MySQL, Oracle	**14**	425.000	**30%**	**SuiteCRM**	**20%**
MACHINALIS	HTML/CSS/JavaScript,	**35**	500.000	**50%**	**Python**	**75%**

	Python LUA		(year 2013)			
ECIC	HTML/CSS/JavaScript, PHP, Java, .NET, Phyton LUA	7	115.000	80%	Fedora	0%
GCOOP	HTML/CSS/JavaScript, Python LUA, Symfony, Flask	18	NA	100%	Tryton, Drupal, SuiteCRM	NA
TECSO	HTML/CSS/JavaScript, C C++, Java, ,NET, Pyhton LUA, MySQL, Struts, Informix	132	540.000	18%	Tryton, Odoo	5%
ENTORNOS EDUCATIVOS	Moodle	14	355.000 (year 2016)	100%	Moodle	80%
X TECH	Phyton, Django	23	710.000 (year 2016)	98%	-	50%

Source: Own elaboration.

Kunan

Kunan is located in Córdoba (Argentina) since 2006. It is specialized in three kinds of activities: CRM (Customer Relationship Management) solutions, dba remote services and mobile solutions. The OS area comprises Customer Relationship Management (CRM) solutions based on SuiteCRM (a fork from SugarCRM that became popular when Sugar discontinued the developments of its open source community edition in 2012) such as installation, customization, development of customized complementary software modules, training, migration and integration services. The area employs 3 workers (over a total of 14), and its sales represent 30% of total sales.

Regarding its innovative activities, the firm habitually devotes all personnel to R&D activities –having an only worker exclusively dedicated to it, which is not properly an R&D department. The staff from the OS area dedicates half of their working time to collaborate with SuiteCRM community in every project where the firm has a business interest. It involves: a) paper writing and lecturing at conferences, b) internal tools development, c) public releasing of modules developed internally, collaborating in FLOSS projects led by other firms or organizations.

The firm does not release complete software, but only specific modules to SuiteCRM. Anyway, it implies an important innovative effort without a direct monetary reward: a significant codification, documentation and translating effort {Polanyi, 1966 #591}, to reach the community standards and norms. For this reason, Kunan releases around 20% of its FLOSS developments. Besides, Kunan led (together with other firms) a national FLOSS project (Libertya, an Open Source ERP) during three years (2010-2013).

Regarding innovation outcomes, the firm introduced product improvements to external FLOSS projects (particularly to SuiteCRM), as

modules and patch solves. These are improvements to products delivered to the FLOSS community that are not (directly) monetized by the firm itself.

Gcoop

Gcoop is a FLOSS work cooperative from the city of Buenos Aires, established in 2007. It is specialized in ERP (Enterprise Recourse Planning) implementations in Tryton (a general purpose application platform under the license in Python that provides the core base of a complete business solution, i.e. accounting, sale management, inventories, etc., as an ERP. See http://www.tryton.org/); development of customized software in Django (Python), SuiteCRM, and Drupal (a free and open source content-management framework to web development. See https://www.drupal.org/; web development services in Drupal; and diverse training services; integrally over FLOSS. In that sense, FLOSS and related services represent 100% of the total sales.

Regarding innovative activities, the firm could not separate its routinized activities from R&D activities, neither calculate an estimated coefficient R&D/sales. Nevertheless, these activities are intense: collaborating in many FLOSS communities and other IT cooperative and social associations; releasing of several modules to FLOSS community; participating in R&D projects together with other FLOSS firms; developing internal projects and activities aimed to experimentation with technologies and ideas.

Gcoop participates in three global FLOSS communities and three national ones: Drupal, SuiteCRM, Tryton; Tryton-ar, Python-ar, and Ubuntu-ar. Collaboration is done, habitually, during working time by all members from the moment when a worker is assigned to a commercial project in a development related to a particular FLOSS (e.g. Tryton). It involves participation in forums and mailing lists, code contributions (modules) and bug corrections (patching), organizing and attending FLOSS events, even donations to some tool or a repository they found useful (i.e.: a github). They have also received collaborations and patches to the projects they led.

Gcoop is a member of Drupal Association (see https://www.drupal.org/gcoop) and is internationally validated as a Drupal services and training provider. It has done two contributions to the Drupal Core of Drupal 8, has participated in 11 Drupal projects, including 3 modules publicly released by the firm. Also, Gcoops appears in the Association as a co-organizer of four regional Drupal events.

Regarding ERP solutions, the firm collaborates with Python and Tryton communities, with public libraries integration and ERP modules respectively.

For many of customized software developments, GCoop participates in SuiteCRM and SugarCRM communities[4], where they have released a module and a utility tool.

The decision on which FLOSS community to belong to is a strategical one in the firm. They chose large communities with successful implementations to show. That allows GCoop to share some of its internal R&D activities and makes it difficult to specify the R&D investments.

The public releasing of code, FLOSS and modules is a habitual activity of Gcoop. In the case of commercial projects, sometimes they offer to the client a lower price for the development if the firm considers it important to release the code, or if it is applicable to other products. There is not a formal agreement regarding intellectual property. Some developments are so customized, that releasing loses utility. These factors affect a calculation of some percentage of liberated software. Some of their internal or social projects (see below) are released directly, or begin as a project led by the firm[5]. In these cases, full programs are released.

The firm is very active in paper writing and lectures at conferences. Internationally it delivered lectures in the LibrePlanet 2014 of the Free Software Foundation (MIT, US), speeches in DrupalCon 2014, Tryton Unconference 2013,

4 See section 3,1 for a characterization of SuiteCRM. Gcoop began to participate in SugarCRM, as long as Sugar sustained the development of a Community Edition (an OS version). SugarCRM stopped this development in 2012, and a fork is SuiteCRM.

5 For a full list of the public releasing of Gcoop (of any kind) , you can consult https://github.com/gcoop-libre

International Free Software Forum of Porto Alegre (Brazil), among others.

In GCoop there are internal projects and activities aimed at experimenting with technologies and ideas, with working time devoted also to projects with social impact. It included, for example, a FLOSS project released publicly called '*Letras Viajeras*' (Traveling Words, see https://github.com/gcoop-libre/letras_viajeras), a software developed for public libraries to generate wifi access to e-books in public transport in the province of Buenos Aires, through mobile devices. They also developed –in collaboration with universities and a non-governmental organization– a Tryton-based software for the management of social entrepreunerships. Among their beneficiaries there are production units of handicapped workers, cultural centers and other social organizations. An example is the development of an ERP for work cooperatives in Tryton that incorporates local specificities. All these are social projects, with a working time assignment. The members of the cooperative have a special interest on the social aims of these projects, which have no commercial ends

The list includes web development for social movements, ERP implementations for firms recovered by workers, Tryton developments for community radio stations, etc. Social innovations and social technologies derive from many of them, and many receive only a partial monetary compensation (others, none).

Machinalis

Machinalis is a software firm from Córdoba established in 2009, specialized in solutions and customized developments using Pyhton technologies in the fields of artificial intelligence, natural language processing, data mining, machine learning, data science and complex web development and process automation. Around 50% of the sales of the firm comes purely from FLOSS development and related services.

Two kinds of software projects are carried out: FLOSS solutions for clients (typical commercial customized developments, using FLOSS tools and technologies), and internal FLOSS projects (not client-oriented). Internal projects are innovation bets of the firm to generate learning processes, develop internal tools, satisfy their workers and reach positions in the market. These projects are fully FLOSS and released to the community, not sold.

Regarding its innovative activities, R&D in Machinalis is transversal to the whole organization. As a result, an R&D department becomes unnecessary. All workers from Machinalis have a formal dedication of working time to collaborate with the FLOSS community, as part of their projects in the firm, both commercial and internal ones. The firm is an active member of the Python community, with members with important international collaborations and a recognized central role in the Python Argentina community.

Collaboration involves intense learning by interacting processes, both for commercial and internal projects. Interaction is useful for the firm to test and validate new codes of the internal projects of Machinalis, receiving continuous feedbacks about its quality, and also problems and bugs. In commercial projects, interaction is also natural (through forums and mailing lists). Also, Machinalis uses interaction with the community to improve the recruitment of personnel (looking for specific cultural values and technical competences), and for marketing purposes. They have a community-based marketing strategy: they promote the firm's abilities and competences through papers and lectures in FLOSS conferences –seeking for visibility of the firm in the industry, and contacting interesting partners and potential clients– and public releasing of FLOSS developed by members of the firm. They are both innovative activities.

Regarding releasing of OS code and FLOSS, they release complete FLOSS, modules and parts, libraries, and tools. Internal projects are fully released, while in commercial projects there are restricted possibilities to liberate the developments. A main obstacle is the property regimes in the contracts with the clients. But even in these cases, the FLOSS can be partially released by the firm when there is some innovation that, though not considered an essential part of the solution, is an essential part of the intellectual capital of Machinalis. This innovation is considered a feedback to the community, and a kind of 'pay back' for the access to free tools and OS code, which also

benefits the clients. Another obstacle to liberation process is the specificity of some solutions in highly customized software developments. As a result, in global terms, Machinalis released around 75% of its software developments.

They led various FLOSS projects in Python technologies, as: Quepy, iEpy, Telegraphy, and MyPy-Django[6]. These are innovation outcomes without a (direct) monetary revenue, but that reinforce the reputation and position of the firm in the market.

ECIC Systems

ECIC Systems is a small firm from Córdoba established in 1986 that offers server administration services. Sales coming from FLOSS related services represent around 80% of the total sales of the firm. The services are provided through an internally developed platform upon a FLOSS, namely PITS router (see http://pitsrouter.com.ar/). PITS router is a software for security networks and centralized control of data traffic that allows the provision of services to networks administrators (VPN administration, web servers, etc.). It is a FLOSS with a GPL license, which is not sold itself but its implementation, configuration, support, and use services of the platform. The software was developed integrally in-house –without collaboration of the FLOSS community– and it is not released publicly due to scarce working time to do it.

One of the owners of ECIC Systems is an Argentinean Ambassador of Fedora community (Fedora is a Linux operating system distribution, it is the community version of an operating system supported by RedHat, which offers an enterprise edition to big clients. See https://fedoraproject.org/) and collaborates frequently. However, collaboration is done in his personal time. This participation includes organizing community events and conferences (e.g. FudCon Cordoba 2015, etc.), delivering speeches and lectures in congresses, giving training courses in FLOSS, managing the LATAM mailing lists and collaborating in the IRC community channels by fixing bugs, answering question, and in some cases, offering code.

The firm does not devote working time (or financial support) to this collaboration activities in the community. The collaboration of the mentioned worker allows ECIC to request for (and receive) free-off-charge confection of documentation needed for its business activity.

Tecso

Tecso is a work cooperative from Rosario (Santa Fe province) established in 2003. It is specialized in customizable software (especially for public sector, entirely FLOSS), software factory (development of parts or modules for other firms), and services such as consultancy and support. Its FLOSS products are focused on ERP solutions and complete software systems development for the public sector, and the FLOSS activities report around 18% of the sales of the firm. Tecso also offers an implementation of some foreign proprietary solutions from IBM to the industrial sector (particularly, around automation) and from Microsoft (a CRM, MS Dynamics).

Regarding innovative activities, Tecso has a formal R&D department (with around 10 permanent workers). In this respect, it behaves as a traditional software firm. The department carries out internal R&D projects, with a particular budget and explicit commercial purposes.

Members of Tecso collaborate with Tryton and Odoo communities[7]. Collaboration is done during working time, as long as a project in ERP is active. That is, the participation is active, but conditioned to the duration of some projects oriented to clients. Participation involves a large series of activities: discussing in mailing lists and forums, solving bugs and problems of the community, reading and writing papers and reports for the community, receiving support about implementation and customization of its FLOSS. However, the firm does not collaborate with the releasing of code or modules in these communities.

6 The FLOSS projects led by Machinalis members could be consulted in https://github.com/machinalis .

7 See section 3.2 for a description of ERP Tryton. The software Odoo is an OS ERP and CRM.

FLOSS development activity of Tecso is done practically all in-house, and releasing is concentrated in complete software systems, through public repositories. In particular, its more successful releasing has been a government solution involving a particular contract/agreement with the client. Two FLOSS of this type are the most relevant: SIAT and GAEM.

SIAT (Sistema Integral de Administracion Tributaria – Integral System of Tax Administration) is a web system to manage activities in tax's calculation, issuance, collection and control. GAEM (Gestión de Actas Electrónicas Móviles - Mobile Electronic Minutes Management) is a system to enact transit infractions using mobile devices (cell phones, tablets, etc.)[8]. Both products were developed for the government of the city of Rosario (SIAT implemented in 2009 and GAEM in 2013), and implied a formal agreement to release them under a copyleft license GNU GPL v3.

After the agreements, the cooperative planned the liberation process and assigned working time to the releasing process. After the public releasing of these systems, many city governments implemented them (the city of Santa Fe, Nogoyá, Córdoba, Morón, Paraná, Villaguay, among others), generating support and implementation services demand, in some cases directly to Tecso. To some extent, the releasing has served to the cooperative as a marketing promotion of the firm, allowing new businesses.

Entornos educativos

The firm *Entornos Educativos* had 14 employees in 2016. It supplies services for the development of virtual education and training platforms on Moodle (a LCMS - Learning Content Management System – platform), in some cases carrying out customized developments and in others, parameterizing existing developments, always in order to generate adaptations of the FLOSS Moodle for local use. Because of it, they are involved in integrating different existing codes and tools in order to replace the gaps that the software presents in this regard (for example: Spanish version of the software, improvements in the form of managing the registrations and monitoring of courses compliance , etc.). In this sense, their R&D and innovation activities are focused on covering the functionalities that the standardized FLOSS does not have.

Therefore, the membership of the firm to the FLOSS community of Moodle is fundamental for its activity. *Entornos Educativos* is a partner of Moodle. This implies the payment of a fee of 10% of all sales, the partnership benefits to the firm being published on the Moodle website – which attracts customers –, access to meetings of updating, and the possibility of being aware of FLOSS development trends –being able to provide opinions and make requests in this regard.

Among the activities carried out within the community there are translations and presentations of Moodle, contributions of codes and correction of errors, organization of local events (Moodle Moots) and dissemination workshops. In general terms, they have not led projects, but they contribute in improvements and modules to the basic software. Additionally, the developers of the company make individual contributions during work hours.

Any participation in the Moodle community is considered training within the company. Indeed, the trained personnel has been recruited under the premise of having knowledge in FLOSS, since the total income from sales in the company comes from products and services linked to it.

The mode of operation of Moodle community leads the firm to constantly releasing its developments in order to stay up-to-date with the latest information. In this way, the firm estimates that 80% of the developments carried out are published in the community.

Regarding social activities, Educational Environments has made campus for free, usually for schools or groups of trainers for low-income people, while the commercial rhythm of the firm has allowed it.

XTech

XTech was founded in 1999 in Buenos Aires and employs 23 workers. It is specialized in IT infrastructure services on a FLOSS background. It

[8] The system could be accessed, downloaded, cloned, etc, in https://github.com/RosarioCiudad/gaem-client-gpl and in https://github.com/RosarioCiudad/gaem-server-gpl

includes consulting, maintenance, and support services to clients, focused on IT systems problem solving. They often provide IT recruiting (body shopping) to their clients. Xtech has a general background on FLOSS, not on a specific one. Almost 98% of the sales of the firm comes purely from FLOSS-related services.

Their innovative activities are very weak. The firm does not devote resources to R&D activities, and software development is a minor activity in XTech, usually as a marginal complement to its services supply. Around 50% of that software sporadically developed was released with a GPL license in public repositories, but not through some FLOSS community. It included, for example, a full FLOSS (an ERP) developed as an internal tool written in java, and a module for XOOPS (a FLOSS CMS - Content Management System).

Any authorization of the clients (or a kind of contract) is needed in the liberation process. An occasional creative activity in XTech has been paper writing, to promote the use of FLOSS and the capabilities of the firm.

They do not participate actively in FLOSS communities during working time, only to get OS code and tools to provide their problem solving services. However, the firm participates in Linux users communities to improve their recruiting mechanisms.

RESULTS AND DISCUSSION. HOW TO MEASURE INNOVATIONS AT FLOSS FIRMS

When analyzing the innovation processes of the five FLOSS firms considered in this study, a set of phenomena or characteristics appear that challenge the adequacy of the Oslo Manual criteria to measure innovations, or that at least called for some adaptations in the indicators recommended.

The innovation particularities of FLOSS firms

In order to facilitate the understanding of how these particular phenomena or characteristics of innovation in FLOSS firms affect the ability of Oslo Manual indicators to measure innovation, we grouped them according to the distinction that the Oslo Manual itself makes between types of innovation (measures of innovative output), and innovative activities and efforts (innovative input measures).

With regard to the particular characteristics of the types of innovation introduced by the FLOSS firms studied, the following are noteworthy:

i) Introduction of new products that are not monetized. It includes development of new products that are not sold, but used by the developer or other users. In the cases there are two clear examples of this type. ECIC Systems developed complete FLOSS, not for the purpose of selling it, but to build on it its service offer. Machinalis developed and released a software seeking to show its capabilities to potential customers, improve its reputation and strengthen its position in the market.

ii) Introduction of improvements to products that are not necessarily monetized. It comprises improvements to 'third party' products that are accepted by the community. It includes improvements that the workers of a firm make in projects of the community, but the collaborating firm can introduce them in its business (using or implementing the improved FLOSS, or providing services on it). Kunan, Gcoop, *Entornos Educativos* and Tecso formally assign working time of their employees to these activities.

iii) Social innovations. Although social innovations are not a prerogative of FLOSS firms, in this type of firms they appear with a relatively high frequency, so their explicit consideration cannot be disregarded in any attempt to measure innovative activity in FLOSS firms. Oslo Manual recognizes the existence of social innovations, but explicitly excludes their treatment. Two of the five firms considered in the study (Kunan and Gcoop) introduced this type of innovations. In one case, innovation was aimed to improve informatics teaching and training in high schools. In the other case, various types of social innovations have been introduced, directed to labor cooperatives, cultural centers, social organizations, disabled workers and even public transport users.

When analyzing the activities and innovative efforts of FLOSS firms, some particularities arise

that can affect their measurement. These characteristics or particular elements are:

a) The public release of complete software and modules. Six of the seven firms studied routinely perform this type of activity. Releasing software requires performing documentation activities, coding, follow-up on the evaluations of the community and corrections, etc. Releasing is a creative activity that demands a significant effort.

b) Development of tools and modules for internal use with OS code.

c) Development of internal projects not linked (in principle) to customers. There are several of these experiences in which these firms devote time to developments that have no predetermined use or purpose, but that, at some point, find a concrete application: in a released innovation that can generate a certain reputation in the market and serve as a marketing strategy (Machinalis), or in new marketable products (Gcoop), or in social innovations (Gcoop).

d) Collaboration in FLOSS projects of 'third parties'. All the firms studied collaborate, to varying degrees and with different degrees of formality, on third-party FLOSS projects.

In addition to these distinctive features related to inputs and outputs of innovation in FLOSS firms, there are two other elements that are very important for characterizing and measuring processes of innovation in FLOSS firms that are not present in other productive activities and must be considered. They are closely related to the role played by the OS community in the innovation process of OS firms.

- A first element that cannot be ignored in the analysis and measurement of innovative activity of firms is that, in some cases, **the 'OS community' appears as a relevant selection actor**, different from the market, accepting some novelties, rejecting others. FLOSS communities become a selection mechanism alternative to the market.
- The second element is that **OS communities can play a role as a R&D pool for FLOSS firms**, especially for SMEs. In these cases, the community acts as a 'huge R&D department' in which the firm participates with its own R&D resources. In the case of Gcoop, the investment in R&D demanded by many of their ideas is too large to be financed by the own firm in isolation, so they should actively seek the support of the community. Kunan benefits from the updates and program improvements made by the Suite CRM community. Machinalis also actively participates in the OS community by making and receiving various contributions and *Entornos Educativos* receives permanent update from Moodle community. This consideration of the role of the OS community in the processes of innovation of the firms does not challenge the way of measuring the innovation proposed by the Oslo Manual, but it questions the idea of using as an indicator of competences the fact of having or not a R&D department, at least in SMEs.
- Another significant element to take into account, although not directly related to the characteristics of the innovation process, is that most of the firms studied have 'hybrid' business models, in the sense that they work in both the proprietary and the free software segments. This means that these FLOSS firms can introduce new or improved products that are monetized or not monetized. In others words, that can be selected by the market, or not.

How these innovation particularities are (or can be) measured?

Once identified the distinctive features of the innovation process in FLOSS firms, it is now necessary to evaluate how these characteristics affect the way in which innovations are measured in the Oslo Manual. Regarding the types of innovations introduced, the results of the analysis are as follows:

A first issue of discussion is whether 'novelties' that are not monetized can be considered innovations. The Oslo Manual measures exclusively innovations of the business sector that are monetized. It recognizes the existence of social innovations that, due to being non-monetized, must be measured using other criteria and indicators, but it does not recognize, or implicitly, deny the existence of business innovations that are not monetized. The analysis of the cases of FLOSS firms outlined in this paper indicates that it is necessary to recognize the existence of business innovations that are not monetized. The problem that appears then is to define a criterion to establish when a novelty is

considered innovation, that can replace the one of successful introduction in the market. Here we propose to follow a similar criterion to that generally adopted in the case of social innovations, which is that of its effective and continuous use (Echeverría, 2008). So, in the case of FLOS firms, this criterion would be the acceptance by the OS community of effective and continuous use of the software in question.

A second issue is how to measure these non-monetized business innovations, since the Oslo Manual does not consider them.

i) In the case of the development of new products that are not monetized, these situations could potentially be captured by the traditional question of whether or not the firm has introduced product innovations, present in almost all the surveys that follow the recommendations of the Oslo Manual. In order to distinguish between innovations in new products that are monetized and not monetized, an additional question asking about the number or the percentage of both types of product innovations could be introduced. Another possibility, better suited for the case of firms that introduce a high number of product innovations, would be to ask for the percentage of development of new products that have been released to the FLOSS community. However, the latter would provide us with a weak proxy indicator, since there are new FLOS developments (e.g. ECIC) which are not released.

ii) Regarding improvements to products from third parties, to measure the introduction of innovations, it is important to differentiate two moments. The first moment is the acceptance of this improvement by 'the community' or the leaders of a particular OS project. The second one is when the leader of the project or any other software firm incorporates the improvement in their business model.

If the criterion closest to the Oslo Manual is followed (innovation occurs in the second moment, when applied in the market) the 'innovator' would be the one who uses or applies it. In this case, this type of product improvements could also be captured through the questions of type of innovations introduced –characteristics of the Oslo Manual– but it does not attribute the innovation to the true developer.

In this way, the innovation efforts (the inputs) appear dissociated from the innovation results (the output), at least partially and at the firm level. That is, while a sole firm or a group of them, or the OS community, carry out the activities and expenses that innovation demands, another or other firms could appear as the introducer of the innovations

On the other hand, if innovation is considered to occur in the moment of acceptance by the community, the collaborating firms become generators of the innovation. Also, in this case, it might be possible to measure the introduction of improvements through questions about types of innovations introduced, distinguishing the developments that the firm performs for, and delivers to, third parties (like FLOSS community projects). Failure to distinguish between these two 'destinations' of introduced product enhancements may bias the results of studies related to introduction of innovations to business performance. This would require additional information. One possibility is to ask about the percentage of product improvements that have been released, delivered and approved by the FLOSS community, although this only allows us to obtain an approximate indicator of improvements for third parties.

Accepting as innovation new or improved product novelties that are not monetized requires new indicators to measure innovative performance of firms, while others –such as the percentage of turnover coming from new products or improved products – lose significance. This is because many product innovations are not monetized by the firm that introduces the novelty, but it can be done by other firms that implement the software to which it has contributed. This also happens in the inverse way: sales of the company itself are affected by product innovations and product improvements that are imbued in the FLOSS used by the community, and this cannot be captured by the percentage of sales that comes from innovation.

iii) Given the frequency with which FLOSS firms introduce social innovations, it is necessary for the surveys to recognize their existence and

importance, even though they are not monetized. Our proposal is to consider them as another type of innovation, without inquiring about the degree of novelty, since it is measured at market level, which is not the selection mechanism relevant for social innovations.

Finally, with regard to how to measure activities and innovation efforts in FLOSS firms, the results of our analysis indicate that:

a) There are activities carried out by FLOSS firms that should be incorporated as innovative. This is the case of efforts to release developments of modules, parts or complete software programs. Releasing is an innovative activity (i.e.: an innovative input), and the release of software or modules published and accepted by the community is a type of product innovation (i.e.: an innovation output).

b) There are other activities carried out by these firms which can be integrated without major problems to the traditional forms of innovation activities foreseen in the Oslo Manual:

- The development of tools and modules for internal use with OS code should be included as a software development activity for internal use of the firm.
- Minor collaborations on 'third party' FLOSS projects (which require bug fixes, bug reports, participation in newsletters, etc.) could be considered as training activities: one of the main motivations of firms to collaborate with the OS community is that this is a way to learn and be constantly updated on the software used.

FINAL REMARKS AND CONCLUSIONS

The main objective of the article was to propose criteria for measuring innovation in software that consider the specificities of the non-monetized innovation generated in the FLOSS community, helping to overcome relevant limitations of the current sectorial surveys based on the Oslo Manual.

Our qualitative analysis, based on 7 FLOSS case studies from Argentina, enabled us to state some preliminary recommendations to improve the measuring of innovation through innovation surveys into the software sector.

FLOSS cases allow us to criticize the predominance of a monetary conception of innovation that underlies typical innovation manual standards regarding how to measure and consider innovation in firms. A broader conception is needed, one that comprises innovations having economic and production impact in society, but that are no longer exclusively generated or selected by market processes.

Together with the results of empirical analysis, other reflections arise from our study, some of them relevant to peripheral economies specificities, which deserve a more profound research. Issue of challenging the relevance of private intellectual property regimes is overwhelming. Alternative regimes are arising in the software sector, like community or collaborative ownership, which show a great innovation performance (even superior to proprietary ownership regimes), and should be seriously studied. Especially due to their development implications for peripheral and emerging economies.

If it is accepted that 'novelties' that are not monetized can be considered innovations, the 'market' loses its central role in determining what is an innovation and when an innovation is generated. Then, in the first place, different types of non-monetized innovations that are characteristic of FLOSS activities were identified: products and developments released publicly and improvements to 'third party' projects from the FLOSS community.

Secondly, accepting as 'innovation' new or improved product novelties that are not monetized requires new indicators to measure innovative performance of firms, the paper makes some recommendations to address this issue. Moreover, other indicators suggested in the standard manuals to measure innovation activities - such as the percentage of turnover coming from new products or improved products- lose importance in the FLOSS sector.

Finally, the consideration of innovations in improvements or new non-monetized products generated within the OS communities requires establishing common criteria about when to consider that an innovation of this type has been introduced. In the paper, arguments are presented in favor of considering that this is the stage of acceptance by the OS community.

This set of considerations enables us to project new studies on the particularities of innovation in FLOSS, in order to make the most of available empirical information, design new measurement instruments and eventually generate new evidence. In this direction, a relevant issue to develop in the near future is the possibility of building a taxonomy of software companies according to their use and production of FLOSS, taking into consideration the business models effectively adopted by the firms of an emerging economy such as Argentina, often in contrast to those systematized in studies carried out in the central countries. In addition, the issue of "social innovations" generated with an important frequency in FLOSS companies in this type of economies is also the basis for new studies derived from this exploratory research.

From the beginnings of the confection of the Innovation Manual, the characteristics of the central economies were taken into account, what generated the subsequent claims from Latin American scholars of the Bogotá Manual. Currently, FLOSS production can contribute to consider specific macroeconomic challenges of peripheral countries, such as savings in external purchases to alleviate the balance of payments and the promotion of import substitution. In that sense, the consideration of FLOSS innovation in surveys is in an early stage, and it is a good opportunity to consider the emerging economies specificities from its very beginning.

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